RECENT SCIENCE ON WIRELESS RADIATION

European Parliament requested a research report "Health Impact of 5G" released in July 2021 concluding that commonly used RFR frequencies (450 to 6000 MHz) are probably carcinogenic for humans and clearly affect male fertility with possible adverse effects on the development of embryos, fetuses and newborns. This is just a sampling of recent research.

Epidemiology only proves the past; Experimental/Toxicology Studies indicate future risks/harms

From time to time people ask, "what are the studies I should share with people who state that there is "no evidence?"

Levitt BB, Lai HC, Manville AM. (2021) Effects of non-ionizing electromagnetic fields on flora and fauna, Part 2 impacts: how species interact with natural and man-made EMF. Rev Environ Health.

- A landmark three part 2021 research review on effects to wildlife published in R*eviews on Environmental Health* by U.S experts including former U.S. Fish and Wildlife senior biologist Albert Manville states current science should trigger urgent regulatory action citing more than 1,200 scientific references which found adverse biological effects to wildlife from even very low intensities of non ionizing radiation with findings of impacts to orientation and migration, reproduction, mating, nest, den building and survivorship (Levitt et al., 2021a, Levitt et al., 2021b, Levitt et al., 2021c).

Uche, U.I., Naidenko, O.V. (2021) "Development of health-based exposure limits for radiofrequency radiation from wireless devices using a benchmark dose approach." Environmental Health 20, 84 (2021)

- The Environmental Working Group published a study in *Environmental Health* analyzing the findings of tumor and heart damage from the National Toxicology Program study and concluded that FCC limits should be strengthened by 200 to 400 times to protect children according to current risk assessment guidelines (Uche 2021).

Frank JW, Electromagnetic fields, 5G and health: what about the precautionary principle? J Epidemiol Community Health Published Online First: 19 January 2021. doi: 10.1136/jech-2019-213595

Anthony B. Miller, L. Lloyd Morgan, Iris Udasin and Devra Lee Davis. "Cancer Epidemiology Update, following the 2011 IARC Evaluation of Radiofrequency Electromagnetic Fields (Monograph 102)" Environmental Research, September 6, 2018.

- Increased risk of brain, vestibular nerve and salivary gland tumors are associated with mobile phone use.
- Literature review: Based on the evidence reviewed it is our opinion that IARC's current categorization of RFR as a possible human carcinogen (Group 2B) should be upgraded to Carcinogenic to Humans (Group 1).

Priyanka Bandara, David O Carpenter, Planetary electromagnetic pollution: it is time to assess its impact, The Lancet Planetary Health, Volume 2, Issue 12, 2018, Pages e512-e514,ISSN 2542-5196, https://doi.org/10.1016/S2542-5196(18)30221-3.

- A recent evaluation of 2266 studies (including in-vitro and in-vivo studies in human, animal, and plant experimental systems and population studies) found that most studies (n=1546, 68·2%) have demonstrated significant biological or health effects associated with exposure to anthropogenic electromagnetic fields.

IARC Working Group on the Evaluation of Carcinogenic Risks to Humans. "IARC monographs on the evaluation of carcinogenic risks to humans. Non-Ionizing Radiation, Part 2: Radiofrequency Electromagnetic Fields." IARC Monographs on the Evaluation of Carcinogenic Risks to Humans/World Health Organization, International Agency for Research on Cancer vol. 102, 2013.

Schuermann D, Mevissen M. Manmade Electromagnetic Fields and Oxidative Stress—Biological Effects and Consequences for Health. *International Journal of Molecular Sciences*. 2021; 22(7):3772. https://doi.org/10.3390/ijms22073772

- "In summary, indications for increased oxidative stress caused by RF-EMF and ELF-MF were reported in the majority of the animal studies and in more than half of the cell studies. Investigations in Wistar and Sprague-Dawley rats provided consistent evidence for oxidative stress occurring after RF-EMF exposure in the brain and testes and some indication of oxidative stress in the heart. Observations in Sprague-Dawley rats also seem to provide consistent evidence for oxidative stress in the liver and kidneys. In mice, oxidative stress induced by RF-EMF was predominantly demonstrated in the brain and testes, as well as in liver, kidneys, and ovaries. These observations were made with a variety of cell types, exposure times, and dosages (SAR or field strengths), within the range of the regulatory limits and recommendations."
- "Adverse conditions, such as diseases (diabetes, neurodegenerative diseases), compromise the body's defense mechanisms, including antioxidant protection mechanisms, and individuals with such pre-existing conditions are more likely to experience health effects. The studies show that very young or old individuals can react less efficiently to oxidative stress, which of course also applies to other stressors that cause oxidative stress. Further investigations under standardized conditions are necessary to better understand and confirm these phenomena and observations."

Lai H.Genetic effects of non-ionizing electromagnetic fields, Electromagn Biol Med. 2021 Feb 4:1-10. doi: 10.1080/15368378.2021.1881866. Epub ahead of print. PMID: 33539186.

Henry Lai (2019) Exposure to Static and Extremely-Low Frequency Electromagnetic Fields and Cellular Free Radicals, Electromagnetic Biology and Medicine, 38:4, 231-248, DOI: 10.1080/15368378.2019.1656645 FCC Filing

- "Changes in free radical activities, including levels of cellular reactive oxygen (ROS)/nitrogen (RNS) species and endogenous antioxidant enzymes and compounds that maintain physiological free radical concentrations in cells, is one of the most consistent effects of EMF exposure. These changes have been reported to affect many physiological functions such as DNA damage; immune response; inflammatory response; cell proliferation and differentiation; wound healing; neural electrical activities; and behavior. An important consideration is the effects of EMF-induced changes in free radicals on cell proliferation and differentiation. These cellular processes could affect cancer development and proper growth and development in organisms. On the other hand, they could cause selective killing of cancer cells, for instance, via the generation of the highly cytotoxic hydroxyl free radical by the Fenton Reaction. This provides a possibility of using these electromagnetic fields as a non-invasive and low side-effect cancer therapy."

Belpomme D, Hardell L, Belyaev I, Burgio E, Carpenter DO. Thermal and non-thermal health effects of low intensity non-ionizing radiation: An international perspective. Environ Pollut. 2018 Nov;242(Pt A):643-658. doi: 10.1016/j.envpol.2018.07.019. Epub 2018 Jul 6. PMID: 30025338.

Kostoff, Ronald N., and Clifford GY Lau. "Combined biological and health effects of electromagnetic fields and other agents in the published literature." Technological Forecasting and Social Change vol. 80, no. 7, 2013, no. 1331-49.

- The present study examined the scope of the combined effects; i.e., identified effects on biological systems from combined exposure to electromagnetic fields/radiation and at least one other agent, concluding that EMF health impacts increase substantially when EMFs function as co-promoters and thus inclusion of co-promoters is essential for modeling real-world effects.

Yakymenko, Igor, et al. "Oxidative mechanisms of biological activity of low-intensity radiofrequency radiation." Electromagnetic Biology and Medicine, vol. 35, no. 2, 2016, pp. 186-202.

Pall M., Wi-Fi is an important threat to human health, Environmental Research Volume 164, July 2018, Pages 405-416

Russell CL. 5G wireless telecommunications expansion:Public health and environmental implications. Environmental Research. April 2018.

Di Ciaula, Towards 5G communication systems: Are there health implications?, Int J Hyg Environ Health. 2018 Feb 2.

Ronald N. Kostoff, Paul Heroux, Michael Aschner, Aristides Tsatsakis, Adverse health effects of 5G mobile networking technology under real-life conditions, Toxicology Letters, Volume 323, 2020, Pages 35-40,

Thermal and non-thermal health effects of low intensity non-ionizing radiation: An international perspective, Environmental Pollution, Volume 242, Part A, 2018, Pages 643-658, ISSN 0269-7491,https://doi.org/10.1016/j.envpol.2018.07.019.

Phillips JL, Singh NP, Lai H. 2009 Electromagnetic fields and DNA damage. Pathophysiology 16:79-88.

Ruediger HW. 2009 Genotoxic effects of radiofrequency electromagnetic fields. Pathophysiology 16:89-102.

Pall, M. Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects. Journal of Cellular and Molecular Medicine, vol. 17, no. 8, 2013 pp. 958-965

- This article reviews a substantially supported set of targets, voltage-gated calcium channels, whose stimulation produces non-thermal EMF responses by humans/higher animals with downstream effects involving Ca2+/calmodulin-dependent nitric oxide increases, which may explain therapeutic and pathophysiological effects of electromagnetic fields.

Hinrikus, Hiie, et al. "Mechanism of low-level microwave radiation effect on nervous system." Electromagnetic Biology and Medicine, 2016.

- Results support the proposed model of excitation by low-level microwave radiation based on the influence of water polarization on hydrogen bonding forces between water molecules, caused by this the enhancement of diffusion and consequences on neurotransmitters transit time and neuron resting potential.

Cucurachi, C., et al. "A review of the ecological effects of radiofrequency electromagnetic fields (RF-EMF)." Environment International, vol. 51, 2013, pp. 116–40.

Singh R., Nath R., Mathur A.K., Sharma R.S., Effect of radiofrequency radiation on reproductive health. *Indian J Med Res.* 2018;148(Suppl):S92–S99. doi:10.4103/ijmr.IJMR_1056_18

Sangün Ö, Dündar B, Çömlekçi S, Büyükgebiz A.,The Effects of Electromagnetic Field on the Endocrine System in Children and Adolescents. Pediatr Endocrinol Rev. 2015 Dec;13(2):531-45.

Kim JH, Lee JK, Kim HG, Kim KB, Kim HR. Possible Effects of Radiofrequency Electromagnetic Field Exposure on Central Nerve System. *Biomol Ther (Seoul)*. 2019;27(3):265–275. doi:10.4062/biomolther.2018.152

Clegg, F., Sears, M., Friesen, M., Scarato, T., Metzinger, R., & Russell, C. et al. (2020). Building science and radiofrequency radiation: What makes smart and healthy buildings. *Building And Environment*, *176*, 106324. https://doi.org/10.1016/j.buildenv.2019.106324

Stein Y, Udassin IG. Electromagnetic hypersensitivity (EHS, microwave syndrome) – Review of mechanisms. Environmental Research. vol. 186. Available online 30 March 2020, 109445.

CANCER

Luo, J., et al Genetic susceptibility may modify the association between cell phone use and thyroid cancer: A population-based case-control study in Connecticut, Environmental Research,Volume 182, 2020

- The interaction between cell phone use and genetic variants on thyroid cancer was investigated in this study. When some genetic variants were present, cell phone use was significantly associated with thyroid cancer. The association increased when cell phone use duration and frequency increased.

Smith-Roe SL., et al., Evaluation of the genotoxicity of cell phone radiofrequency radiation in male and female rats and mice following subchronic exposure, Environ Mol Mutagen 2020; 61 (2): 276-290

National Toxicology Program (NTP) Carcinogenesis Studies of Cell Phone Radiofrequency Radiation, Final Reports

The NTP studies found that high exposure to RFR used by cell phones was associated with:

- Clear evidence of tumors in the hearts of male rats. The tumors were malignant schwannomas.
- Some evidence of tumors in the brains of male rats. The tumors were malignant gliomas.
- Some evidence of tumors in the adrenal glands of male rats. The tumors were benign, malignant, or complex combined pheochromocytoma.
- Resources on the NTP study:
  - National Institutes of Health Cell Phone Webpage: This page has the key findings, final reports and a factsheet for the public.
  - Factsheet on NTP Study for Public (January 2020)
  - Study on DNA damage from the NTP
  - PPT on Peer Review
  - Toxicology and Carcinogenesis Studies in Hsd:**Sprague Dawley SD Rats** Exposed to Whole-Body Radio Frequency Radiation at a Frequency (900 MHz) and Modulations (GSM and CDMA) Used by Cell Phones
  - Toxicology and Carcinogenesis Studies in **B6C3F1/N Mice** Exposed to Whole-Body Radio Frequency Radiation at a Frequency (1,900 MHz) and Modulations (GSM and CDMA) Used by Cell Phones

Carlberg, Michael and Lennart Hardell. "Evaluation of Mobile Phone and Cordless Phone Use and Glioma Risk Using the Bradford Hill Viewpoints from 1965 on Association or Causation." BioMed Research International, vol. 2017, 2017.

- When considered vis a vis deductive public health principles, the combined evidence from epidemiology and laboratory studies indicate that meningioma and glioma in the temporal lobe can be considered to be caused by cumulative RF radiation exposure. Experimental findings that RF increases production of reactive oxygen species suggest a potential mechanism.

Lerchl, Alexander, et al. "Tumor promotion by exposure to radiofrequency electromagnetic fields below exposure limits for humans." Biochemical and Biophysical Research Communications, vol. 459, no. 4, 2015, pp. 585-90.

- Numbers of tumors of the lungs and livers in exposed animals were significantly higher than in sham-exposed controls. In addition, lymphomas were also found to be significantly elevated by exposure.

Prasad, M., et al. "Mobile phone use and risk of brain tumours: a systematic review of association between study quality, source of funding, and research outcomes." Neurological Sciences, 2017.

- Studies with higher quality are more likely to find higher risk of brain tumour, while lower quality studies tend to indicate lower risk/protection

Belpoggi et al. 2018, "Report of final results regarding brain and heart tumors in Sprague-Dawley rats exposed from prenatal life until natural death to mobile phone radiofrequency field representative of a 1.8 GHz base station environmental emission" Environmental Research

- "Our findings of cancerous tumors in rats exposed to environmental levels of RF are consistent with and reinforce the results of the US NTP studies on cell phone radiation, as both reported increases in the same types of tumors of the brain and heart in Sprague-Dawley rats. Together, these studies provide sufficient evidence to call for the International Agency for Research on Cancer (IARC) to re-evaluate and re-classify their conclusions regarding the carcinogenic potential of RFR in humans"

Hardell, Lennart and Michael Carlberg. "Mobile phone and cordless phone use and the risk for glioma–Analysis of pooled case-control studies in Sweden, 1997–2003 and 2007–2009." Pathophysiology, vol. 22, no. 1, 2015, pp. 1-13.

- Mobile phone and cordless phone use increased the risk of glioma, with highest risk in the >15–20 years latency group Highest ORs overall were found for ipsilateral mobile or cordless phone use, while the highest risk was found for glioma in the temporal lobe. First use of mobile or cordless phone before the age of 20 gave higher OR for glioma than in later age groups.

Carlberg, Michael and Lennart Hardell. "Decreased survival of glioma patients with astrocytoma grade IV (glioblastoma multiforme) associated with long-term use of mobile and cordless phones." International Journal of Environmental Research and Public Health, vol. 11, no. 10, 2014, pp. 10790-805.

- Elevated HR (decreased survival) for the most malignant glioma type, astrocytoma grade IV, was found for long-term use of mobile and cordless phones. Highest HR was found for cases with first use before the age of 20 years.

Coureau, Gaëlle, et al. "Mobile phone use and brain tumours in the CERENAT case-control study." Occupational and Environmental Medicine, vol. 71, no. 7, 2014, pp. 514-22.

- No association with brain tumours was observed when comparing regular mobile phone users with non-users, however, the positive association was statistically significant in the heaviest users when considering life-long cumulative duration and number of calls for gliomas. Risks were higher for gliomas, temporal tumours, occupational and urban mobile phone use.

West JG, Kapoor NS, Liao S, Chen JW, Bailey L, Nagourney RA. (2013). Multifocal Breast Cancer in Young Women with Prolonged Contact between Their Breasts and Their Cellular Phones. Case Reports in Medicine. Volume 2013, Article ID 354682.

- Researchers report a four case series of women-ages from 21 to 39-with multifocal invasive breast cancer, all which regularly carried their cell phones against their breast for up to 10 hours/day for several years, had no family history of breast cancer, tested negative for BRCA1 and BRCA2, and have highly similar case pathology and morphology.

Yang, M., et al. "Mobile phone use and glioma risk: A systematic review and meta-analysis." PLoS One, vol. 12, no. 5, 2017.

- Meta-analysis found significant positive association between long-term mobile phone use (minimum, 10 years) and glioma. And there was a significant positive association between long-term ipsilateral mobile phone use and the risk of glioma. Long-term mobile phone use was associated with 2.22 times greater odds of low-grade glioma occurrence.

HEAD AND NECK TUMORS

Carlberg, Michael, et al. "Increasing incidence of thyroid cancer in the Nordic countries with main focus on Swedish data." BMC Cancer, vol. 16, no. 426, 2016.

- The main finding of this register based study was an increasing incidence of thyroid cancer in Sweden during the whole study period 1970–2013 in both women and men, although not statistically significant in men. In both genders the incidence increased during the more recent study period, from 2001 in women and from 2005 in men.

Sadetzki, Siegal, et al. "Cellular Phone Use and Risk of Benign and Malignant Parotid Gland Tumors–A Nationwide Case-Control Study." American Journal of Epidemiology, vol. 167, no. 4, 2007, pp. 457-67.

- Our results suggest a relation between long-term and heavy cellular phone use and parotid gland tumors. This association was seen in analyses restricted to regular users, analyses of laterality of phone use, and analyses of area of main use.

Siqueira, Elisa Carvalho, et al. "Cell phone use is associated with an inflammatory cytokine profile of parotid gland saliva." Journal of Oral Pathology & Medicine, vol. 45, no. 9, 2016, pp. 682-6.

- Cell phone exposure was associated with an increased level of IL-1β (a pro-inflammatory cytokine) and decreased IL-10 level (anti-inflammatory cytokine) in the exposed parotid gland saliva .

Reproduction

Houston, B.J., et al. "The effects of radiofrequency electromagnetic radiation on sperm function." Reproduction, vol. 152, no. 2, 2016, pp. R263-76.

- Documented impacts of RF-EMR on the male reproductive system include decreased sperm motility, elevated levels of reactive oxygen species, increased DNA damage, and decreased antioxidant levels.

Adams, Jessica A., et al. "Effect of mobile telephones on sperm quality: A systematic review and meta-analysis." Environmental International, vol. 70, 2014, pp. 106-12.

- Following a systematic review and meta-analysis to determine whether exposure to RF-EMR emitted from mobile phones affects human sperm quality, researchers found that exposure to mobile phone was associated with reduced sperm motility and overall quality.

De Iuliis, Geoffry N., et al. "Mobile phone radiation induces reactive oxygen species production and DNA damage in human spermatozoa in vitro." PloS one, vol. 4, no. 7, 2009.

- RF-EMR in both the power density and frequency range of mobile phones (1.8 GHz covering a SAR range from 0.4 to 27.5 W/kg) were shown to enhance mitochondrial reactive oxygen species generation, decrease the motility and vitality, stimulating DNA base adduct formation and ultimately cause DNA fragmentation within the human spermatozoa.

Atasoy, Halil I., et al. "Immunohistopathologic demonstration of deleterious effects on growing rat testes of radiofrequency waves emitted from conventional Wi-Fi devices." Journal of Pediatric Urology, vol. 9, no. 2, 2013, pp. 223-9.

- Researchers observed significant increases in serum 8-hydroxy-2′-deoxyguanosine levels and 8-hydroxyguanosine staining in the testes of the experimental group indicating DNA damage due to exposure (p < 0.05) and effects on enzyme activity.

Avendano, Conrado, et al. "Use of laptop computers connected to internet through Wi-Fi decreases human sperm motility and increases sperm DNA fragmentation." Fertility and Sterility, vol. 97, no. 1, 2012, pp. 39-45.

- Sperm samples, mostly normozoospermic, exposed ex vivo during 4 hours to a wireless internet-connected laptop showed a significant decrease in progressive sperm motility and an increase in sperm DNA fragmentation.

BRAIN

Aldad, Tamir S., et al. "Fetal radiofrequency radiation exposure from 800-1900 Mhz-rated cellular telephones affects neurodevelopment and behavior in mice." Scientific Reports, vol. 2, no. 312, 2012.

- In a study examining the association between prenatal cell phone use and hyperactivity in children, researchers found that mice exposed in-utero were hyperactive and had impaired memory, and in addition, recordings of excitatory postsynaptic currents revealed that these behavioral changes were due to altered neuronal developmental programming.

Byun, Yoon-Hwan, et al. "Mobile phone use, blood lead levels, and attention deficit hyperactivity symptoms in children: a longitudinal study." PLoS One, vol. 8, no. 3, 2013.

Foerster M., Thielens A., Joseph W., Eeftens M., Röösli M. (2018) A prospective cohort study of adolescents' memory performance and individual brain dose of microwave radiation from wireless communication.Environmental Health Perspectives.

Kim, Ju Hwan, et al. "Long-term exposure to 835 MHz RF-EMF induces hyperactivity, autophagy and demyelination in the cortical neurons of mice." Scientific Reports, vol. 7, 2017.

- The neuronal effects of 835 MHz RF-EMF on the cerebral cortex of the mouse brain at 4.0 W/kg for 5 hours/day for 12 weeks included induction of autophaygy genes, production of proteins, accumulation of autolysosome, demyelination in cortical neurons and hyperactivity-like behavior.

Volkow, Nora D., et al. "Effects of cell phone radiofrequency signal exposure on brain glucose metabolism." JAMA, vol. 305, no. 8, 2011, pp. 808-13.

- Researchers concluded that compared to individuals with no exposure, 50-minute cell phone exposure was associated with increased brain glucose metabolism in the region closest to the antenna.

Bas, O., et al. "Chronic prenatal exposure to the 900 megahertz electromagnetic field induces pyramidal cell loss in the hippocampus of newborn rats." Toxicology and Industrial Health, vol. 25, no. 6, 2009, pp. 377-84.

- It was found that 900 megahertz of electromagnetic field significantly reduced the total pyramidal cell number in the cornu ammonis of the electromagnetic field group (P < 0.001).

Deshmukh, Pravin Suryakantrao, et al. "Cognitive impairment and neurogenotoxic effects in rats exposed to low-intensity microwave radiation." International Journal of Toxicology, vol. 34, no. 3, 2015, pp. 284-90.

- Rats exposed to low-intensity microwave radiation showed declined cognitive function, elevated HSP70 level, and DNA damage within the brain, compared to control animals.

Herbert, Martha R., and Cindy Sage. "Autism and EMF? Plausibility of a pathophysiological link–Part I." Pathophysiology, vol. 20, no. 3, 2013, pp. 191-209.

- Authors review pathophysiological damage to core cellular processes that are associated both with autism spectrum conditions and with biological effects of EMF/RFR exposures that contribute to chronically disrupted homeostasis

Herbert, Martha R., and Cindy Sage. "Autism and EMF? Plausibility of a pathophysiological link part II." Pathophysiology, vol. 20, no. 3, 2013, pp. 211-34.

- Authors document how behaviors in autism spectrum conditions may emerge from alterations of electrophysiological oscillatory synchronization, how EMF/RFR could contribute to these by de-tuning the organism, and policy implications of these vulnerabilities.

Odaci, E., O. Bas, and S. Kaplan. "Effects of prenatal exposure to a 900MHz electromagnetic field on the dentate gyrus of rats: a stereological and histopathological study." Brain Research, no. 1238, 2008, pp. 224-9.

- The results showed that prenatal EMF exposure caused a decrease in the number of granule cells in the dentate gyrus of the rats (P<0.01), suggesting that prenatal exposure to a 900 MHz EMF affects the development of the dentate gyrus granule cells in the rat hippocampus.

Sonmez, O.F., et al. "Purkinje cell number decreases in the adult female rat cerebellum following exposure to 900 MHz electromagnetic field." Brain Research, no. 1356, 2010, pp. 95-101.

- Results showed that the total number of Purkinje cells in the cerebellum of the EMFG was significantly lower than those of CG (p<0.004) and SG (p<0.002), suggesting that long duration exposure to 900 MHz EMF leads to decreases of Purkinje cell numbers in the female rat cerebellum.

Tang, Jun, et al. "Exposure to 900MHz electromagnetic fields activates the mkp-1/ERK pathway and causes blood-brain barrier damage and cognitive impairment in rats." Brain Research, no. 1601, 2015, pp. 92-101.

- Results demonstrate that exposure to 900 MHz EMF radiation for 28 days can significantly impair spatial memory and damage BBB permeability in rat by activating the mkp-1/ERK pathway.

Papageorgiou, Charalabos C., et al. "Effects of wi-fi signals on the p300 component of event-related potentials during an auditory hayling task." Journal of Integrative Neuroscience, vol. 10, no. 2, 2011, pp. 189-202.

- The present study focused on the possible gender-related effects of Wi-Fi electromagnetic fields (EMF) on the attention and working memory operations of the brain, concluding that Wi-Fi exposure may exert gender-related alterations on neural activity associated with the amount of attentional resources engaged during a linguistic test.

Ntzouni, Maria P, et al. "Transient and cumulative memory impairments induced by GSM 1.8 GHz cell phone signal in a mouse model." Electromagnetic Biology and Medicine, vol. 32, no. 1, 2013, pp. 95-120.

- The data suggest that visual information processing mechanisms in hippocampus, perirhinal and entorhinal cortex are gradually malfunctioning upon long-term daily exposure, a phenotype that persists for at least 2 weeks after interruption of radiation, returning to normal memory performance levels 4 weeks later.

Federico Bertagna, Rebecca Lewis, S Ravi P Silva, Johnjoe McFadden, Kamalan Jeevaratnam. Effects of electromagnetic fields on neuronal ion channels: a systematic review. Ann N Y Acad Sci. 2021 May 4. doi: 10.1111/nyas.14597.

- Here, we systematically clarify how neuronal ion channels are particularly affected and differentially modulated by EMFs at multiple levels, such as gating dynamics, ion conductance, concentration in the membrane, and gene and protein expression. Ion channels represent a major transducer for EMF-related effects on the CNS.

ENVIRONMENT

Several literature reviews warn that non-ionizing EMFs are an "emerging threat" to wildlife (Balmori 2015, Curachi 2013, Sivani 2012) and impacts to pollinators are documented in published studies (Favre 2011, Kumar et.al., 2011, Lazaro et al., 2016). Field research has found years of exposure to cell tower radiation damages trees (Waldmann-Selsam, C., et al. 2016, Helmut 2016, Haggerty 2010) and plants (Halgamuge 2017, Pall 2016, Halgamuge and Davis 2019). Radiofrequency radiation has been found to affect the magnetic sense of invertebrates (including insects) (Tomanová and Vácha, 2016; Vácha et al., 2009) birds (Engels et al., 2014) and mammals (Malkemper et al., 2015). Furthermore research shows bees and pollinators could suffer serious impacts from the higher frequencies to be used in 5G as the higher frequencies resonate with their bodies resulting in up to 370% higher absorbed power.

Balmori, Alfonso. "Anthropogenic radiofrequency electromagnetic fields as an emerging threat to wildlife orientation." Science of The Total Environment, vol. 518–519, 2015, pp. 58–60

- The growth of wireless telecommunication technologies causes increased electrosmog. Radio frequency fields in the MHz range disrupt insect and bird orientation.
- Radio frequency noise interferes with the primary process of magnetoreception. Existing guidelines do not adequately protect wildlife. Further research in this area is urgent.

Thielenset al., "Exposure of Insects to Radio-Frequency Electromagnetic Fields from 2 to 120 GHz" Scientific Reports volume 8, Article number: 3924 (2018)

Waldmann-Selsam, C., et al. "Radiofrequency radiation injures trees around mobile phone base stations."Science of the Total Environment 572 (2016): 554-69.

Breunig, Helmut. "Tree Damage Caused By Mobile Phone Base Stations An Observation Guide." (2017).

You can also download the Tree Observation Guide at: Competence Initiative for the Protection of Humanity, the Environment and Democracy

S Sivani, D Sudarsanam, Impacts of radio-frequency electromagnetic field (RF-EMF) from cell phone towers and wireless devices on biosystem and ecosystem ? A review, Volume 4, Issue 4, Pages 202–216, 2012

Haggerty, Katie. "Adverse Influence of Radio Frequency Background on Trembling Aspen Seedlings."International Journal of Forestry Research2010.836278 (2010).

Halgamuge, M.N. "Weak radiofrequency radiation exposure from mobile phone radiation on plants."Electromagnetic Biology and Medicine, vol. 36, no. 2, 2017, pp. 213-235.

Martin Pall. "Electromagnetic Fields Act Similarly in Plants as in Animals: Probable Activation of Calcium Channels via Their Voltage Sensor"Current Chemical Biology, Volume 10 , Issue 1 , 2016

Shikha Chandel, et al. "Exposure to 2100 MHz electromagnetic field radiations induces reactive oxygen species generation in Allium cepa roots."Journal of Microscopy and Ultrastructure 5.4 (2017): 225-229.

Halgamuge MN, Davis D. Lessons learned from the application of machine learning to studies on plant response to radio-frequency. Environ Res. 2019. doi:10.1016/j.envres.2019.108634

Compliance Testing and Exposures

Gandhi, O. P. (2019). Microwave Emissions From Cell Phones Exceed Safety Limits in Europe and the US When Touching the Body. IEEE Access, 7, 47050-47052.

Fernández, A.A. de Salles, M.E. Sears, R.D. Morris, D.L. Davis, Absorption of wireless radiation in the child versus adult brain and eye from cell phone conversation or virtual reality, Environmental Research, 2018, ISSN 0013-9351

Ferreira, Juliana Borges, and Álvaro Augusto Almeida de Salles. "Specific Absorption Rate (SAR) in the head of Tablet users." 7th Latin American Workshop On Communications, 2015

- The psSAR simulations in heterogeneous models (adult and child) show higher levels in the children model.

Gultekin, David H., and Lothar Moeller. "NMR imaging of cell phone radiation absorption in brain tissue." Proceedings of the National Academy of Sciences, vol. 110, no. 1, 2013, pp. 58-63.

- A method is described for measuring absorbed electromagnetic energy radiated from cell phone antennae into ex vivo brain tissue.

Morris, Robert D., Lloyd L. Morgan, and Devra L. Davis. "Children Absorb Higher Doses of Radio Frequency Electromagnetic Radiation From Mobile Phones Than Adults." IEEE Access, vol. 3, 2015, pp. 2379-87.

Gandhi, Om P., et al. "Exposure limits: the underestimation of absorbed cell phone radiation, especially in children." Electromagnetic Biology and Medicine, vol. 31, no. 1, 2012, pp. 34-51.

- Researchers indicate that the existing cell phone certification process is outdated and greatly underestimates the SAR for typical phone users, especially children, and thus call for a new certification process that incorporates different modes of use, head size, tissue properties, and anatomically based models.

Cardis, Elisabeth, et al. "Risk of brain tumours in relation to estimated RF dose from mobile phones: results from five Interphone countries." Occupational and Environmental Medicine, vol. 68, no. 9, 2011, pp. 631-40.

- Authors found suggestions of an increased risk of glioma in long-term mobile phone users with high RF exposure and of similar, but apparently much smaller, increases in meningioma risk.

Cells

Markovà, Eva, Lars OG Malmgren, and Igor Y. Belyaev. "Microwaves from mobile phones inhibit 53BP1 focus formation in human stem cells more strongly than in differentiated cells: possible mechanistic link to cancer risk." Environ Health Perspect, vol. 118, no. 3, 2010, pp. 394-9.

- Microwaves from mobile phones inhibited formation of 53BP1 foci in human primary fibroblasts and mesenchymal stem cells. These data parallel our previous findings for human lymphocytes.

Belyaev, Igor Y., et al. "Microwaves from UMTS/GSM mobile phones induce long-lasting inhibition of 53BP1/γ-H2AX DNA repair foci in human lymphocytes." Bioelectromagnetics, vol. 30, no. 2, 2009, pp. 129-41.

- Researchers described frequency-dependent effects of mobile phone microwaves on human lymphocytes from persons reporting hypersensitivity to electromagnetic fields and healthy persons, concluding that microwaves from universal global telecommunications system (UMTS) mobile phones affect chromatin and inhibit formation of DNA double-strand breaks in human lymphocytes from both hypersensitive and healthy persons.

NON-THERMAL EFFECTS AND MECHANISMS OF INTERACTION BETWEENELECTROMAGNETIC FIELDS AND LIVING MATTER RAMAZZINI INSTITUTE Edited by Livio Giuliani and Morando Soffritti https://20f26590-b7e8-4680-97ed-4c278e3cde44.filesusr.com/ugd/71af9c_bb3a19dd1379425aa765fc5de60498e5.pdf

IMPACTS TO INSECTS AND WILDLIFE

A 2020 report of the "biological effects of electromagnetic fields on insects" by high voltage, mobile communications and WLAN came to the conclusion that, in addition to pesticides and the loss of habitats, mobile communications radiation also has negative effects on insects and is therefore another factor in weakening the insect world. **Read "Biological effects of electromagnetic fields on insects" by Alain Thill**

Several literature reviews warn that non-ionizing EMFs are an "emerging threat" to wildlife (Balmori 2015, Curachi 2013, Sivani 2012) and impacts to pollinators are documented in published studies (Balmori 2021, Favre 2011, Kumar et.al., 2011, Lazaro et al., 2016). Field research has found years of exposure to cell tower radiation damages trees (Waldmann-Selsam, C., et al. 2016, Helmut 2016, Haggerty 2010) and plants (Halgamuge 2017, Pall 2016, Halgamuge and Davis 2019). Radiofrequency radiation has been found to affect the magnetic sense of invertebrates (including insects) (Tomanová and Vácha, 2016; Vácha et al., 2009) birds (Engels et al., 2014) and mammals (Malkemper et al., 2015). Furthermore researchshows bees and pollinators could suffer serious impacts from the higher frequencies to be used in 5G as the higher frequencies resonate with their bodies resulting in up to 370% higher absorbed power.

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You can also download the Tree Observation Guide at: Competence Initiative for the Protection of Humanity, the Environment and Democracy

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